



1. CODES AND STANDARD

- ◆ IEC : International Electrotechnical Commission
- ◆ NEC : National Electrical Code
- ◆ ANSI : American National Standards Institute
- ◆ IEEE : Institute of Electrical and Electronic Engineers
- ◆ NEMA : National Electrical Manufacturers Association
- ◆ API : American Petroleum Institute
- ◆ NFPA : National Fire Protection Association
- ◆ JEC : Japanese Electrotechnical Committee
- ◆ JEM : Japanese Electrical Manufacturers Association

2. HAZARDOUS AREA

가.

	IEC	NEC	JIS
(1000)	Zone 0	Division 1	0
(10~1000)	Zone 1		1
(0.1~10)	Zone 2	Division 2	2

1) **Zone 0** ()

- ◆ Gas Vapor 가 가
- ◆ Tank , Pipe Line Equipment

2) **Zone 1** ()

- ◆ Normal 가 가
- ◆ Maintenance, Repair 가 가

3) **Zone 2** ()

- ◆ , Emergency Condition 가 가
- ◆ , 가 가 ,
- ◆ Positive Mechanical Ventilation 가 Vapor
Ventilating Equipment
가
Zone I Area Positive
Pressure Ventilation ,
Safeguard 가 , 가 가

. GAS GROUP

가 가
Group .

1) IEC Code

GROUP	Chemicals
IIA	Acetone, Ammonia, Amyl acetate, Aniline, Benzene, n-Butanol, Carbon monoxide, Cyclohexane, Cyclohexanol, Ethane, Ethanol, Ethyl acrylate, n-Heptane, n-Hexane, Hexanol, Kerosene, Methane, Methanol, Naphtha, Nitroethane, Nitromethane, n-Nonane, Propane , Styrene, Toluene, Vinyl acetate, Xylene
IIB	Acrolein, Acrylonitrile, 1,3-Butadiene, Cyclopropane, Diethyl ether, Ethylene , Ethylene oxide, Methyl acetate, Coke-oven gas
IIC	Acetylene , Carbon Disulfide, Hydrogen

2) NEC Code

- ◆ Group A : Acetylene
- ◆ Group B : Hydrogen or Manufactured Gas
- ◆ Group C : Ethyl-Ether Vapors, Ethylene
- ◆ Group D : Gasoline, Hexane, Naphtha, Benzene, Butane, Propane, Alcohol, Acetone, Benzol, Lacquer-solvent vapor, Natural gas

3. Type of Protection ()

		가	Zone
	Flameproof	d	1, 2
	Pressurization	p	1, 2
	Increased Safety	e	2
	Intrinsic Safety	ia, ib	0*, 1, 2
	Oil Immersion	o	1, 2
	Powder Filling	q	2
	Encapsulation	m	1, 2
	Special	s	1, 2

* ia : Zone 0, 1, 2 ib : Zone 1, 2 (Not Zone 0)

가

Zone 0 : Intrinsic Safety (ia)
Zone 1 : Zone 0 + Intrinsic Safety (ib), Flame-proof (d), Pressurization (p), Oil-Immersion (o)
Zone 2 : Zone 1 + Zone 2 + Increased Safety (e)

가. (Flame-Proof, “d”)

가

가

- ◆
- ◆
- ◆

가 가 가

(Pressurization, “p”)

(Protective Gas)

가

- ◆ (Protective Gas)

()

가

(LEL, Lower Explosion Limit)

가

Air, Nitrogen

가 가

- ◆ Alarm , (ISA-S12.4 Instrument Purging – Zone 2 Area Type Z Purge)
- (Increased Safety, “e”) Normal Arc Spark , Arc Spark , ,
- (Intrinsic Safety, “ia, ib”) IEC 79-11 Test () Energy Intrinsically-safe circuit .
- ◆ 가 가 Energy 가 가 Energy .
- ◆ 가 , 가 .
- (Oil Immersion, “o”) Arc Spark 가 가 가 가 가 .

4. Temperature Classification “T”

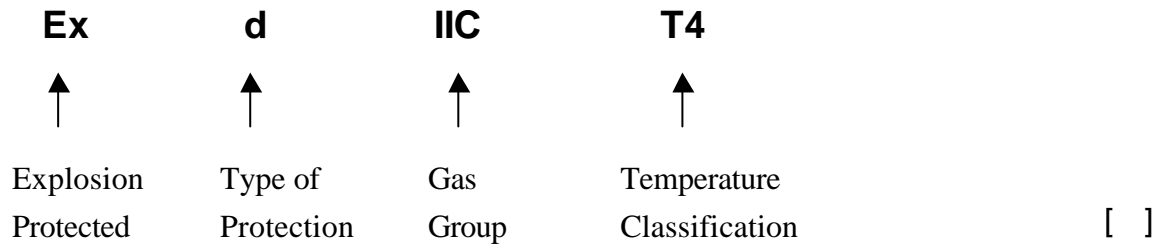
Temperature Design -20 +40 Ambient 가

IEC 79-8 6 가 .

Temp. Class	T1	T2	T3	T4	T5	T6
Maximum Surface Temperature ()	≤ 450	≤ 300	≤ 200	≤ 135	≤ 100	≤ 85

5.

“Exd IIC T4” ,



1.

1) (耐壓) (Flame proof enclosure “d”)

, 가
 가 가 가 가
 , 가 ,
 가 , 가
 가 가 가 가 가

(1) (Width of joint) 가

(2) (Gap of flameproof joint)

(3)

(Maximum Experimental Safe Gap) , , A, B, C
 가 가

(4)

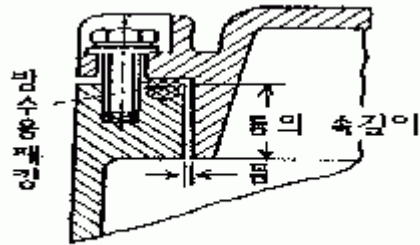
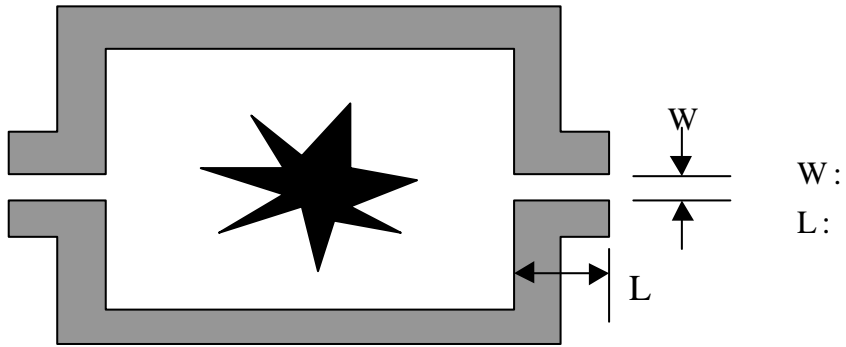
가 가 , 가
 가 가
 (5)

(6)

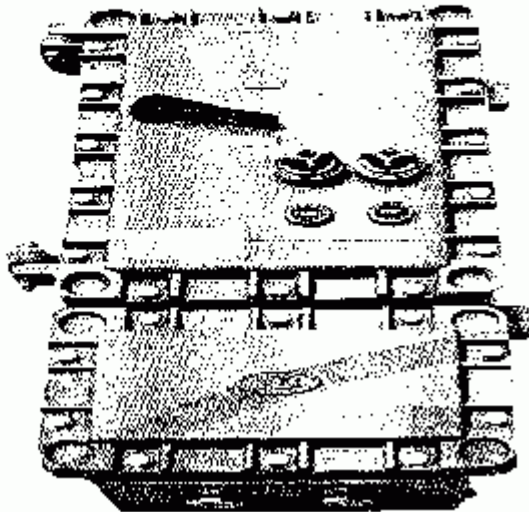
(7)

가 , , MCB,
 Motor

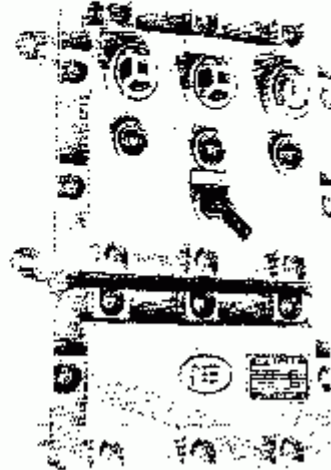
(8)



CLASSIFICATION
Exd II B T4
Class I - Groups C, D



CLASSIFICATION
 Excl. IIB T4
 Class I, Groups C, D



CLASSIFICATION
 Excl. IIC T4
 Class I, Groups B, C, D



Ceiling
 EULH 3012



40' Bracket
 EULH 3042

2) (Increased Safety “e”)

1

2

, Air Gap,

가

가

(1) (Limiting Temperature)

2 가

가. 가

(2) (Clearance)

가

(3)

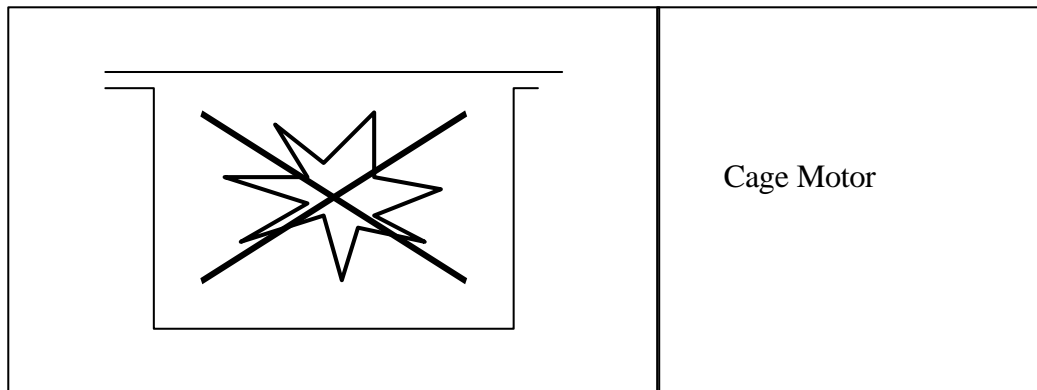
가

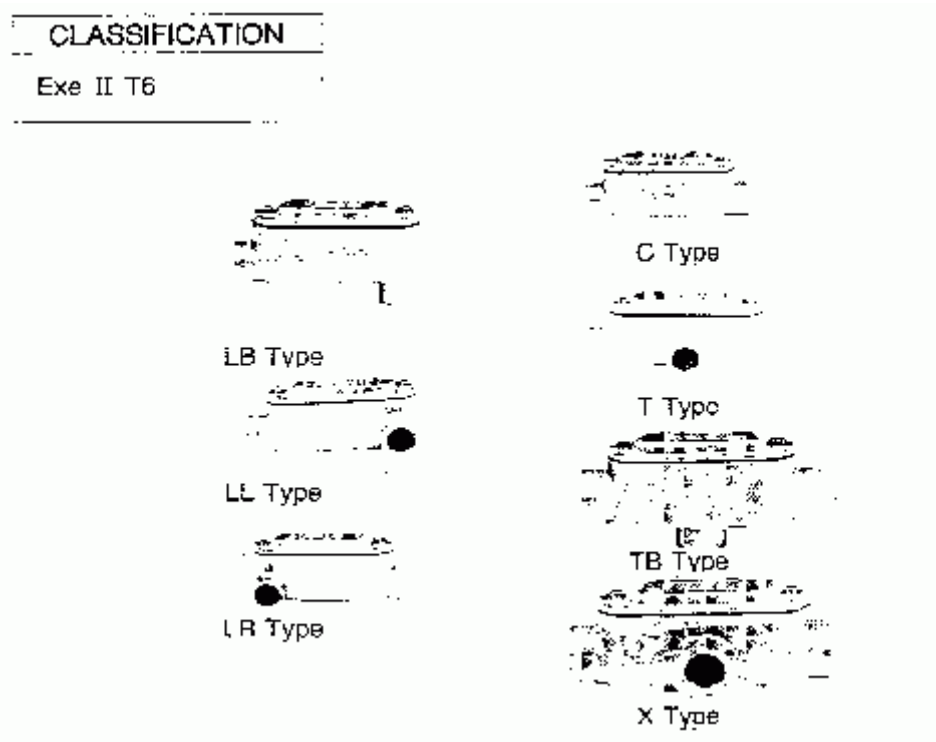
(4)

(5)

가

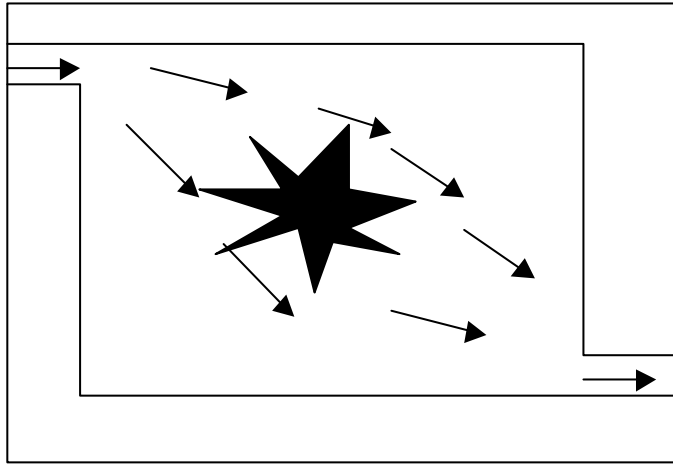
(6)





- 3) (壓力) (Pressurized Apparatus "P")
- 가 , 가 가 가
- 50pa (5mm H₂O) 가 가
- 가 , 가
- 가 가 가 가
- 가 가 (Z Purge,)
- (X Purge,)
- (1) , , .
- (2) , , .
- (3) , , .
- (4) 가 .
- 가 Panel .

(5)



4) (Oil Immersion "O")

2

가 가
 (Mineral Oil) 가 가
 가 가

(1)

(2)

가 가 가

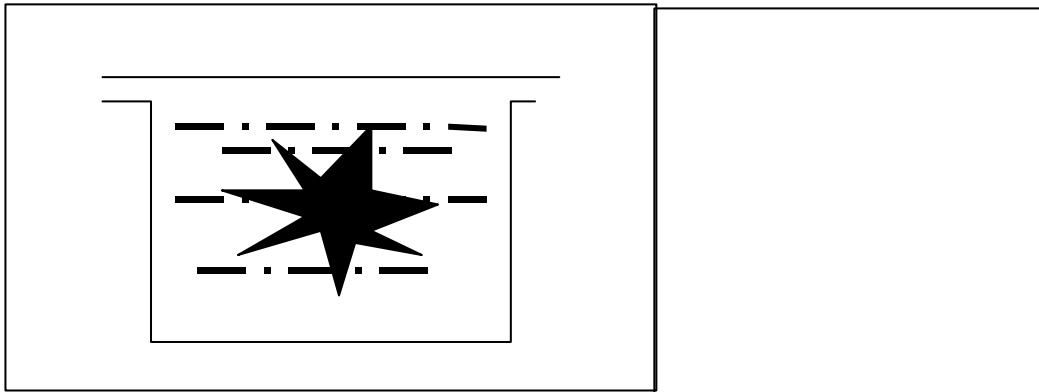
(3)

가.
 . 가 .

(4)

, , , MCB,

(5)



5) (Intrinsic Safety “ia, ib”)

0 , 1 , 2

Class I Division 1

가

가

가

가

가

가

(

가

(1)

가

가 가 가

(2)

가

(3)

가

가

(4)

A, B, C

(5)

가. a

1

가

2

가

가

가

b

1

가

가

가

(6)

가. 30V, 50 mA 가

가

. 50V, 150mA

가 가

DC 4~20mA

30V

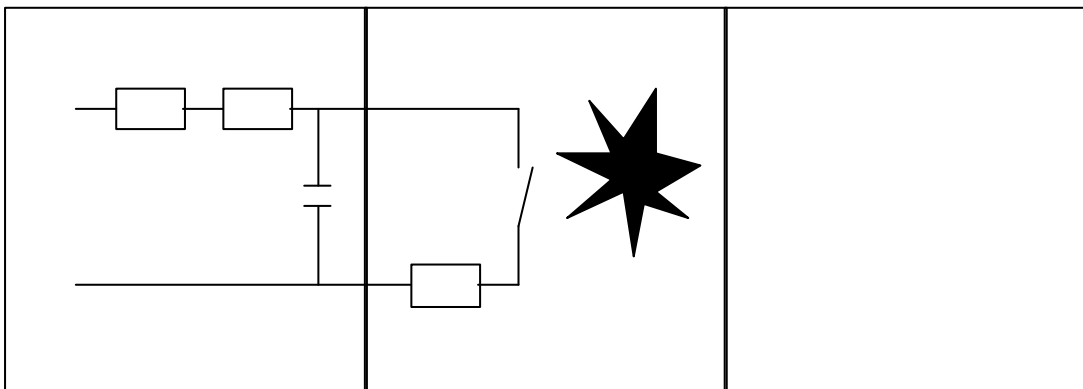
가

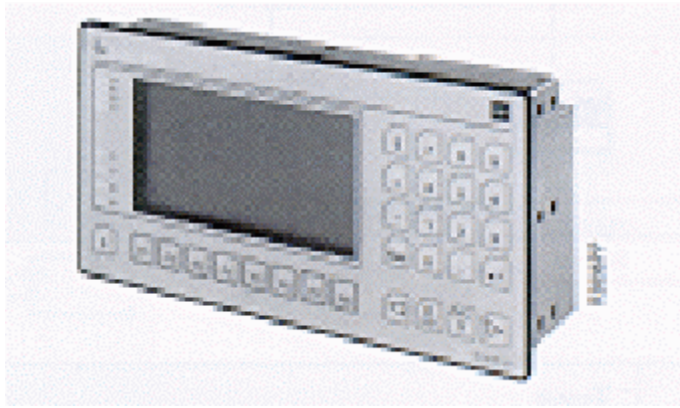
(7)

(8)

Thermocouple, Switch, Flow, Temperature, Pressure Transmitter

(9)





6) (Sand Filled Type) 가 가 가

7) (Mould Type) 가 가

8) (Non-incendive Type) 가 가

(1) A 가

(2) B

(3) R

(가 가)

2.

1)

가							
/	d	e	p	o	ia,ib	-	s
	FLP	-	-	-	FLP	-	-
	EXd	EXe	EXf	EXo	EXi	EXq	Exs
	EXd	EXe	-	EXo	EXi	EXq	Exs
	EXd	EXe	EXf	EXo	EXi	Exq	-
	Exd	EXe	EXf	EXo	-	-	Exs
	Xt	Xh	Xv	Xo	Xi	-	Xs
IEC	EXd	EXe	EXp	EXo	Exia,ib	Exq	Exs

2)

) **Exd** A T4

Ex d IIA T₄

: Explosion
Proof

가

: (d, p, e, o, ia, ib) (IIA, IIB, IIC) (T₁, T₂ T₃ T₄ T₅ T₆)

3.

PLANT

가

PLANT

1) 가

2) 가

3)

4)

5) , ,

6) 가 , 가 , 가

7) 가

8) 2 가 가 가 가

9) 가

5.



1) 가 가 Room
 Compressor Room (Ground Level Grating Concrete) Hydrogen 가
 Compressor 가
 4m
 Compressor Motor
 Compressor Room Gasoline 가
 2
) Motor
 1. 가?
 가
 Hydrogen 가 가 가
 1 (Zone 1)
 1 가 Exd Type
 2. 가 가 가?
 Hydrogen 가 가 0.28mm
 C , 가 520 T1
 Gasoline
 Gasoline 280 T3
 3. Compressor Room Exd C
 T3 Motor Exe T3



2) 가 2

Ethane, Ethylene 가 Analyzer

House Analyzer,

가? , Analyzer

Analyzer 가 .

)

1. 가 가 가 가

가 가 가 가

1 (Zone 1) .

Exd ,

2. 가 가 가?

Ethane A T1, Ethylene B T2

Ethylene

B T2 .

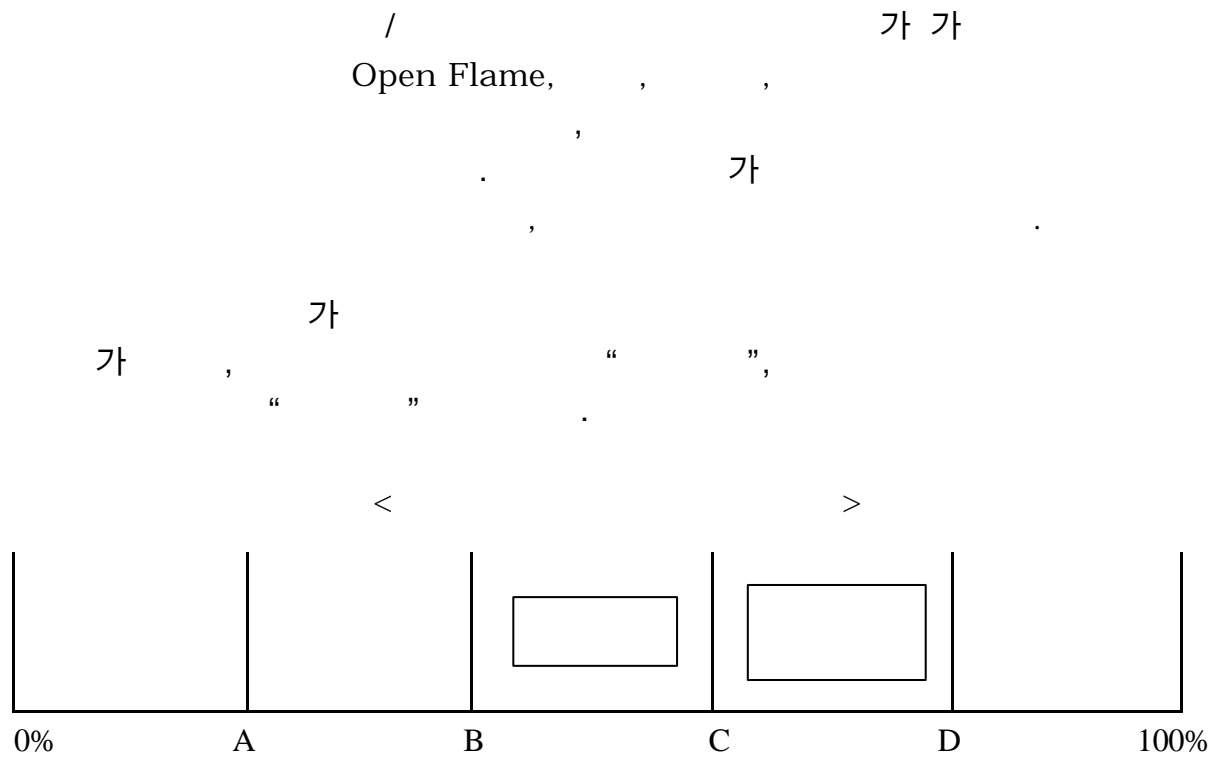
3. , Exd B T2

, .

6.

ELECTRICAL APPARATUS		ZONE 1		ZONE 2	
		A & B	C	A & B	C
Induction Motor	L/V	Ex d IIB T4	Ex d IIC T4	Ex e II T4	
	H/V	-	-		
Synchronous Motor Exciter		-	-	Ex d T4 or Ex p T4	
Plug & Receptacle, LV MCC, Control Switches		Ex d IIB T4	Ex d IIC T4	Ex d IIB T4	Ex d IIC T4
Electrical Facility for Hoist Electric Valve Actuator		Ex d IIB T4	Ex d IIC T4	Ex e II T4	Ex e II T4
Lighting Distribution Panel and Control Panel		Ex d IIB T6 Ex p II T6	Ex d IIC T6 Ex p II T6	Ex d IIB T4	Ex d IIC T4
Lighting Fixture	Fluorescent Lamp	Ex d IIB T4	Ex d IIC T4	Ex e II T4	
	Incandescent Lamp			Ex e II T2	
	MH/HPS/Mercury Lamp	Ex p II T4	Ex p II T4		
Coupling, Union, Adapter, LB, Tee, Terminal Box, Cable Gland		Ex d IIB T6	Ex d IIC T6	Ex e II T6	
Sealing Fitting		Ex d IIB T6	Ex d IIC T6	Ex d II T6	

1.



)

	A	B	C	D
GAS	6%	14%	20%	40%
(H)	4%	14%	34%	76%
(CH)	5%	8%	9%	15%

가 가 ,
가 가

2.

가 , , 가 가 . 가
 1 가 가 가 .
 가 가 .

- 1) (Heat) : , , , 가 , , 가 ,
- 2) (Electrical Sparks) : , , , ,
- 3) (Mechanical Sparks) : (Friction or Grinding), (Hammering)

3.

- 1) (Hazardous Area)
 가 가 /
 가 가 , ,
 0 , 1 , 2 .
- 2) (Non-hazardous Area)
 가 가 가 ..
- 3) 가 가 /
 .
- 4) (Source of release)
 가 , , , ,
 .
- 5) (Ignitable Mixture)
 가 .

- 6) (Flash Point)
 가 가 ,
 가
- 7) (Auto Ignition Point)
 가 가 가
 가
- 8) (Flammable/Explosion Range)
 가 가 가
 가 가
 가 (Lower Flammable Limit) 가
 가 가 (Upper Flammable Limit)
- 9) 가 (Combustible Material)
 가 ,
 가
- 10) (Flammable Liquid)
 가 37.8
 37.8 40psia
 가
 22.8 37.8 Class A.
 22.8 37.8 Class B.
 22.8 37.8 Class C.
- 11) 가 (Combustible Liquid)
 가
 37.8 가
 37.8 60 Class .
 60 93.4 Class A.
 93.4 Class B.
- 12) (Maximum Experimental Safe Gap)
 8 , 25mm 가
 가 가

- 13) (Minimum Ignition Energy)
가
- 14) (Minimum Igniting Current Ratio)
가
- 15) 가 가 (Lighter than air gas)
가 가 가 가 가 가 가 가 가
- 16) 가 가 (Heavier than air gas)
가 가 가 가 가 가 가 가 가
- 17) / 가 (Compressed and liquefied gas)
가 가 가 가 가 가 가 가 가
- 18) (Cryogenic Liquid)
101
가

4.

가
가 , Code 가

	NEC (1984)	IEC Pub. 79-0(1983)
0 : 가	Class : 가 , Class I Division 1 - 가 가 , 가 가	Zone 0 : 가 가
1 : 가 가	- 가 , 가 , 가 - Break Down 가 가 , 가	Zone 1 : 가 가
2 : 가	Class I Division 2 - , Break Down, 가 , - 가 가 , 가 , 가 가 - Division 1 , 가 , 가	Zone 2 : 가 가
	Class : 가 Class : 가	

1) IEC

가

, 가 가

0 , 1 2 ,

(1) 0 (Zone 0)
가

- 가. Vent 가 (Vessel)
- . IFRT (Internal Floating Roof Tank)
- . Open (Vessel), (Pit)
- . Exhaust Duct

(2) 1 (Zone 1)
() 가 가

- 가. , 가
- . 가
- . 가 Compressor 가 Pump Room.
- . 가
- . Vent

(3) 2 (Zone 2)
가

가

- 가. 가
- . 가 (Gasket), (Packing)
- . 가 / 가

가

(4) 가. 가 가 가
 가 가
 . , .
 . 가 . 가
 . 가 , 가 , 가
 가 ,
 가 가
 가

2) (NEC)

NFPA 497 NEC 500 Class
 Division 1/Division 2 IEC Zone0, 1, 2
 , 가 IEC IEC

(1) Class Division 1 : 가 가 가

(2) Class Division 2 : 가 가 가

(3) Class : 가 (Dust)

(4) Class : 가 (Fiber)

IEC 0 1 (Zone 0 & 1) Class I Division 1 ,
 2 (Zone 2) Class I Division 2 .

5. 가

가 가 가 A, B, C 가

1) 가 25mm

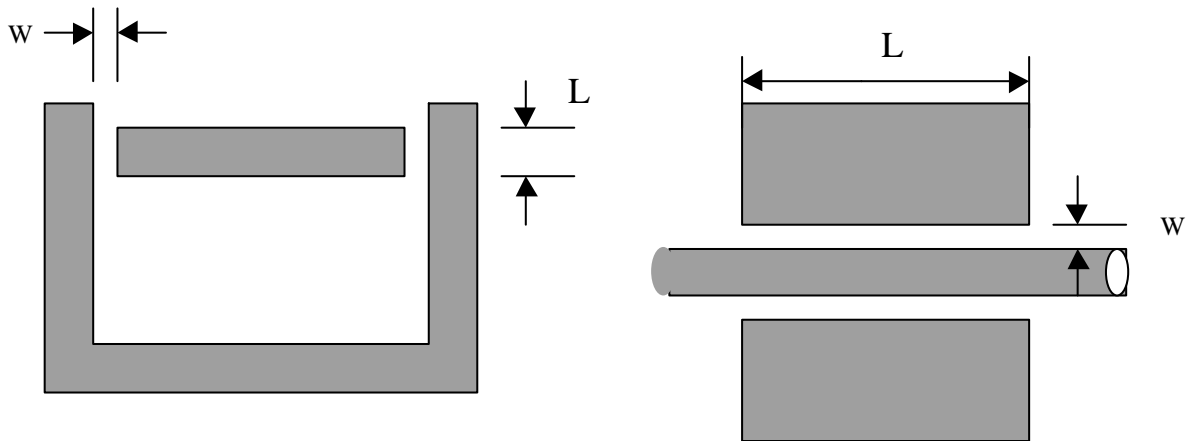
(MESG : Maximum Experimental Safe Gap)

가

- (1) A: 가 0.9mm 가
- (2) B: 가 0.5mm 0.9mm 가
- (3) C: 가 0.5mm 가

< 가 MESG >

	Vol. %	MESG	MESG	()
Methane	8.2	1.14	0.11	I ()
Propane	4.2	0.92	0.03	IIA
Cyclo hexanol	3.0	0.95	0.03	IIA
Methanol	11.0	0.92	0.03	IIA
Ethylene	6.5	0.65	0.02	IIB
Acetylene	8.5	0.37	0.01	IIC
가 (H ₂)	27.0	0.29	0.01	IIC



W: , L:

2) IEC Gas Group

Gas Group	Gas
IIA	Acetone, Ammonia, Amyl acetate, Aniline, Benzene, n-Butanol, n-Butyl acetate, Carbon monoxide, Cumene, Cyclohexane, Cyclohexanol, Cyclohexanone, p-Cymene, o-Dichlorobenzene, 1,2-Dichloroethylene, Diethylamine, Diethylaminoethanol, Dimethylamine, Ethane, Ethanol, Ethyl Acrylate, Ethyl Formate, n-Heptane, n-Hexane, Hexanol, Kerosene, Methane, Methanol, Methyl Methacrylate, Methylamine, Monoethanolamine, Naphtha, Nitroethane, Nitromethane, n-Nonane, Nonyl Alcohol, n-Octyl Alcohol, 1-Pentanol, Propane, 1-Propanol, Pyridine, Styrene, Toluene, Triethylamine, Vinyl Acetate, Xylene
IIB	Acrolein, Acrylonitrile, 1,3-Butadiene, Crotonaldehyde, Cyclopropane, Diethyl ether, 1,4-Dioxane, Ethylene, Ethylene oxide, Hydrogen Cyanide, Methyl Acetate, Tetrahydrofuran, Town gas, Coke-oven gas
IIC	Acetylene, Carbon Disulfide, Hydrogen

3) NEC Gas Group

Gas Group	가
Group D	Acetone, Alcohol Ammonia, Benzene, Gasoline, Solvent, Butane, Heptane
Group C	Ethylene, Cyclopropane, Ethyl Ether, Acetaldehyde, Isoprene
Group B	Butadiene, Ethylene Oxide, Propylene Oxide, Acrolein, H ₂ , 30% 가
Group A	Acetylene

4) : Temperature Classification “T”

가 가 (AIT : Auto-Ignition Temperature)

6

< 가 T - rating (NFPA 497 Table 2-1) >

	가
T1	Aniline, Carbon Monoxide, Cresol, Methane, Methyl Chloride,
T2	Acrilonitle, Acetone, Ammonia, n-Amyl Acetate Benzene, 1,3-Butadiene, 2-Butanol, Butylene, n- Butyl Acetate, Ethanol, Ethane, Ethyl, Chloride, Ethyl Alcohol, Ethyl Benzene, Ethyl Acetate, Ethylene, Oxide, Hydrogen, Isobutane, LPG, Methanol, Methyl Acetate, Methyl, Alcohol, Nitrobenzene, Propane, Propylene, n-Propyl Acetate, Propylene, Oxide, Propylene, Pyridine, Styrene, Toluene, Vinyl Chloride, Xylen, Xylidine
T3	Acetylene, Acrolein, 1-Butanol, n-Butane, Cumene, Cyclohexane, n-Decanol, Ethyl Mercaptan, Morpholine, Gasoline, Isohexane, Naphtha, n-Pentane
T4	Acetaldehyde, Isooctyl Aldehyde, Fuel Oil 1, n-Heptane, n-Hexane, Isoprene, Kerosene, n-Octane
T5	CS ₂ , ClO ₂ , Diethyl Ether, Ethyl Ether
T6	Carbon Disulfide

- 20

+ 40 .

“T Class”

<Table 1-2, T - Rating of Electrical Apparatus>

	T1	T2	T3	T4	T5	T6
()	450	300	200	135	100	85

5) Gas Group

()		(NEC, 1984)		(IEC Pub. 79-0, 1983)	
		가 Group			
		Group ()	(mm)	Group ()	(mm)
A	0.9	D	0.9	A	0.9
B	0.5 0.9	C, B	0.5 0.9	B	0.5 0.9
C	0.5	B, A	0.5	C	0.5
T1	450	T1	450	T1	450
T2	300 ~ 450	T2	300	T2	300
T3	200 ~ 300	T2A	280	T3	200
T4	135 ~ 200	T2B	260	T4	135
T5	100 ~ 135	T2C	230	T5	100
T6	85 ~ 100	T2D	215	T6	85
		T3	200		
		T3A	180		
		T3B	165		
		T3C	160		
		T4	135		
		T4A	120		
		T5	100		
		T6	85		

가	IEC (79-1)	NFPA 70(NEC) / API
Methane		D
Propane	A	
Ethylene	B	C
Hydrogen	C	B
Acetylene		A

National Electrical Code

- * Class I : Flammable gases, vapors & Flammable/Combustible liquids.
 - Class II : Combustible dusts.
 - Class III : Ignitable fibers or flyings.

- * Division 1 : Where the hazard is considered to exist under Normal conditions.
 - Division 2 : Where the hazard is considered to exist due to abnormal conditions.

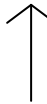
- * Group A : Atmospheres containing Acetylene
- * Group B : Atmospheres containing Hydrogen, Process gases containing more than 30% Hydrogen, Butadiene, Oxide or Propylene Oxide
- * Group C : Atmospheres containing Ethylene or Ethyl
- * Group D : Atmospheres containing Acetone, Ammonia, Benzene, Methane, Ethane, Butane, Propane, Hexane or Natural Gas
- * Group E : Atmospheres containing Combustible metal dusts such as Al, Mg and their alloys
- * Group F : Atmospheres containing Combustible Carbonaceous dusts such as Carbon black, Charcoal or Coal
- * Group G : Atmospheres containing Combustible dusts not included in E&F, including Flour, Grain, Wood, Plastics or Chemical

(International Electro-technical Commission, Korea Industrial Safety CO, KS, JIS, NEC)

	IEC or KISCO	KS or JIS	NEC
	Exd	d	Class I DIV 1&2
	Exe	e	Class I DIV 2
	Exp	p	Class I DIV 1&2
	Exo	o	Class I DIV 2
	Exia, Exib	ia, ib	Class I DIV 1&2
	Exs	s	-
	SDP	SDP	Class II
	DP	DP	Class II
	EDP	XDP	Class II
	가 (,)		Class II

	(KISCO)		Group			
			IEC / KISCO	KS / JIS	NEC	
	II	가 가 ,	A	1	C, D	
			B	2		
			C	3		
				11	11	E, F, G
				12	12	
				13	13	
	I		-			

(°C / °F)	IEC or KISCO	KS or JIS	NEC
450 / 842	-	G1	-
450 / 842	T1	G2	T1
300 / 572	T2	G3	T2
280 / 536			T2A
260 / 500			T2B
230 / 446			T2C
215 / 419			T2D
200 / 392	T3	G4	T3
180 / 356			T3A
165 / 329			T3B
160 / 320			T3C
135 / 275	T4	G5	T4
120 / 248			T4A
100 / 212	T5	G6	T5
85 / 185	T6	-	T6

	IEC or KISCO	KS or JIS	NEC
Hazardous  Non-Hazardous	Zone 0	0	Division 1
	Zone 1	1	
	Zone2	2	Division 2
	Non-Hazardous	Non-Hazardous	Non-Hazardous